

The listing of claims will replace all prior versions and listings of claims in the application:

**Listing of Claims:**

Claim 1 (currently amended) A method for real-time digital spectral analysis of wide-band signals comprising ~~the steps of~~:

- receiving a wide-band signal;
- shifting the center frequency of the wide-band signal by a small fraction  $\varepsilon$  of its bandwidth;
- sampling and digitizing the wide-band signal;
- processing the digitized wide-band signal using a digital filter; and,
- decimating the digitally filtered wide-band signal.

Claim 2 (currently amended) A method for real-time digital spectral analysis of wide-band signals comprising ~~the steps of~~:

- receiving a wide-band signal;
- shifting the center frequency of the wide-band signal by a small fraction  $\varepsilon$  of its bandwidth;
- sampling and digitizing the wide-band signal;
- de-multiplexing the digitized wide-band signal into  $N$  parallel sample streams;
- processing the  $N$  parallel sample streams in parallel using  $N$  digital FIR filters;
- and,
- determining  $2^k \cdot N; k = 0, 1, \dots$  sub-band signals by decimating the sample stream from each digital FIR filter by a factor of  $2^k \cdot N; k = 0, 1, \dots$ , wherein only every  $2^k \cdot N^{th}; k = 0, 1, \dots$  sample is retained and the others are discarded.

Claim 3 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 2, wherein the wide-band signal is sampled at a sample rate of at least twice the bandwidth of the wide-band signal.

Claim 4 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 2, wherein each of the  $N$  digital FIR filters has a different tap-weight.

Claim 5 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 4, wherein each digital FIR filter is a cosine symmetric digital FIR filter having a linear phase.

Claim 6 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 5, wherein the bandwidth of each digital FIR filter is approximately  $1/N$  of the bandwidth of the wide-band signal.

Claim 7 (currently amended) A method for real-time digital spectral analysis of wide-band signals as defined in claim 2, comprising ~~the step of~~ re-quantization by re-scaling and truncating the  $2^k \cdot N; k = 0, 1, \dots$  sub-band signals in order to reduce downstream processing load.

Claim 8 (currently amended) A method for real-time digital spectral analysis of wide-band signals as defined in claim 2, comprising ~~the step of~~ phase rotating the  $2^k \cdot N; k = 0, 1, \dots$  sub-band signals by phase  $\varepsilon$  using a digital phase rotator producing a de-rotated sub-band signal.

Claim 9 (currently amended) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band, the method comprising ~~the steps of~~:

receiving  $2^k \cdot N; k = 0, 1, \dots$  pairs of first and second de-rotated sub-band signals at  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators, wherein each pair is received at a different cross-correlator of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators;

delaying one of the first and second de-rotated sub-band signals with respect to the other in a series of delay intervals at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators;

forming the product of the first and the second de-rotated sub-band signals at each of the delay intervals at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators;

producing a sub-band cross-correlation result at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators by summing the products over a period of time;

transforming each sub-band cross-correlation result at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators by means of a Fourier Transform into a cross-spectrum result; and,

correcting each cross-power spectral point of each sub-band cross-spectrum result with a sub-band scaling term, a gain differential compensation term, a bandshape correction term and a wide-band power gain term.

Claim 10 (original) A method for cross-correlation de-rotated sub-band signals sub-band by sub-band as defined in claim 9, comprising digital sub-sample delay interpolation of the de-rotated sub-band signals.

Claim 11 (original) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band as defined in claim 9, wherein the delay intervals are equivalent to one sample-interval of a sub-band signal.

Claim 12 (original) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band as defined in claim 9, wherein the Fourier Transform is performed after each period of time of summing the products.

Claim 13 (currently amended) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band as defined in claim 9, comprising ~~the step of~~ band flattening each of the  $2^k \cdot N; k = 0, 1, \dots$  sub-band cross-spectra.

Claim 14 (currently amended) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band as defined in claim 9, comprising ~~the step of~~ scaling each of the  $2^k \cdot N; k = 0, 1, \dots$  sub-band cross-spectra by a cross spectrum weighting function.

Claim 15 (currently amended) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band as defined in claim 9, comprising ~~the step of~~ concatenating the  $2^k \cdot N; k = 0, 1, \dots$  sub-band cross-spectra to obtain a wide-band spectrum.

Claim 16 (currently amended) A method for cross-correlating de-rotated sub-band signals sub-band by sub-band, the method comprising ~~the steps of~~:

receiving  $2^k \cdot N; k = 0, 1, \dots$  pairs of first and second de-rotated sub-band signals at  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators, wherein each pair is received at a different cross-correlator of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators;

transforming each pair of first and second de-rotated sub-band signals at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators by means of a Fourier Transform into frequency domain;

complex cross-multiplying the Fourier transformed first and second de-rotated sub-band signals at each of the  $2^k \cdot N; k = 0, 1, \dots$  cross-correlators; and,

time-averaging the cross-multiplied first and second de-rotated sub-band signals.

Claim 17 (currently amended) A method for real-time digital spectral analysis of wide-band signals comprising ~~the steps of~~:

receiving a first and a second wide-band signal;

shifting the center frequency of each of the first and the second wide-band signal by a small fraction  $\varepsilon_1$  and  $\varepsilon_2$ , respectively, of its bandwidth;

sampling and digitizing the first and the second wide-band signal;

de-multiplexing each of the digitized first and second wide-band signals into first  $N$  parallel sample streams and second  $N$  parallel sample streams;

processing each of the first and the second  $N$  parallel sample streams in parallel using  $2 \cdot N$  digital FIR filters;

determining first and second  $N$  sub-band signals by decimating the sample stream from each digital FIR filter by a factor of  $N$ , wherein only every  $N^{th}$  sample is retained and the others are discarded;

re-quantizing the  $N$  sub-band signals by re-scaling and truncating in order to reduce downstream processing load;

phase rotating each of the first and second  $N$  sub-band signals by phase  $\varepsilon_1$  and  $\varepsilon_2$ , respectively, using a digital phase rotator producing first and second  $N$  de-rotated sub-band signals;

receiving pairs of the first and second  $N$  de-rotated sub-band signals at  $N$  cross-correlators, wherein each pair is received at a different cross-correlator of the  $N$  cross-correlators;

delaying one of the first and second de-rotated sub-band signals with respect to the other in a series of delay intervals at each of the  $N$  cross-correlators;

forming the product of the first and the second de-rotated sub-band signals at each of the delay intervals at each of the  $N$  cross-correlators;

producing a sub-band cross-correlation result at each of the  $N$  cross-correlators by summing the products over a period of time;

transforming each sub-band cross-correlation result at each of the  $N$  cross-correlators by means of a Fourier Transform into a cross-spectrum result;

correcting each cross-power spectral point of each sub-band cross-spectrum result with a sub-band scaling term, a gain differential compensation term, a bandshape correction term and a wide-band power gain term; and,

concatenating the  $N$  sub-band cross-spectra to obtain a wide-band spectrum.

Claim 18 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 17, wherein the frequency shifts  $\varepsilon_1$  and  $\varepsilon_2$  are arbitrary.

Claim 19 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 18, wherein the frequency shifts  $\varepsilon_1$  and  $\varepsilon_2$  are varied in a quasi-random way during a period of time of summing the products.

Claim 20 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 17, wherein the first and the second wide-band signal are a same wide-band signal.

Claim 21 (currently amended) A method for real-time digital spectral analysis of wide-band signals of a phased array system comprising ~~the steps of~~:

- receiving  $M$  wide-band signals from the phased array system;
- shifting the center frequency of each of the  $M$  wide-band signals by a small fraction  $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_m$ , respectively, of its bandwidth;
- sampling and digitizing the  $M$  wide-band signals;
- de-multiplexing each of the digitized  $M$  wide-band signals into  $M \cdot N$  parallel sample streams;
- processing each of the  $M \cdot N$  parallel sample streams in parallel using  $M \cdot N$  digital FIR filters;
- determining  $M \cdot N$  sub-band signals by decimating the sample stream from each digital FIR filter by a factor of  $N$ , wherein only every  $N^{\text{th}}$  sample is retained and the others are discarded;
- re-quantizing the  $M \cdot N$  sub-band signals by re-scaling and truncating;
- complex mixing each of the  $M \cdot N$  re-quantized sub-band signals;
- $90^\circ$  phase shifting one of two components of each of the complex mixed  $M \cdot N$  sub-band signals; and,
- forming multiple beams by adding same sub-band components of the  $M \cdot N$  sub-bands, the same sub-band components being provided by same digital FIR filters.

Claim 22 (original) A method for real-time digital spectral analysis of wide-band signals as defined in claim 21, comprising digital sub-sample delay interpolation of the digitized  $M$  wide-band signals.

Claim 23 (original) A system for real-time digital spectral analysis of wide-band signals comprising:

- a port for receiving a wide-band signal;
- a frequency shifter for shifting the center frequency of the wide-band signal by a small fraction  $\varepsilon$  of its bandwidth;
- an A/D converter for sampling and digitizing the wide-band signal;
- a de-multiplexer for de-multiplexing the digitized wide-band signal into  $N$  parallel sample streams; and,
- $N$  processors, each processor for processing one of the  $N$  parallel sample streams by digitally FIR filtering and decimating the sample stream in order to determine a sub-band signal.

Claim 24 (original) A system for real-time digital spectral analysis of wide-band signals as defined in claim 23, wherein the frequency shifter the center frequency comprise an analog mixer and a local oscillator.

Claim 25 (original) A system for real-time digital spectral analysis of wide-band signals as defined in claim 23, wherein the frequency shifter the center frequency comprise a digital single-sideband mixer.

Claim 26 (original) A system for real-time digital spectral analysis of wide-band signals as defined in claim 23, wherein each of the  $N$  processors re-quantizes the sub-band signal.

Claim 27 (original) A system for real-time digital spectral analysis of wide-band signals as defined in claim 23, wherein each of the  $N$  processors digitally phase rotates the sub-band signal by phase-rate  $\varepsilon$ .

Claim 28 (original) A system for real-time digital spectral analysis of wide-band signals as defined in claim 27, wherein each of the  $N$  processors digitally cross-correlates the sub-band signal with a respective second sub-band signal.